UDC 615.451.1:582.585.61

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THE ANTIBACTERIAL PROPERTIES OF ETHANOLIC EXTRACTS OBTAINED FROM LEAVES OF SOME PLANTS BELONGING TO THE *SANSEVIERIA* THUNB. GENUS AGAINST *ACINETOBACTER BAUMANNII* STRAIN

АНТИБАКТЕРІАЛЬНІ ВЛАСТИВОСТІ ЕТАНОЛЬНИХ ЕКСТРАКТІВ, ОТРИМАНИХ З ЛИСТЯ ДЕЯКИХ РОСЛИН, ЩО НАЛЕЖАТЬ ДО РОДУ *SANSEVIERIA* THUNB. ЩОДО ШТАМУ *ACINETOBACTER BAUMANNII*

DOI: 10.58407/bht.2.22.3

ABSTRACT

Purpose: In study, an attempt has been made to evaluate the antibacterial activity of seventeen plants belonging to the *Sansevieria* genus against *Acinetobacter baumannii* complex isolate, resistant to gentamicin and ciprofloxacin (specimen 3680, UK NEQAS). The aim of the present study was to evaluate the antibacterial capacity and to validate scientifically the inhibitory activity of some plants belonging to the *Sansevieria* genus for microbial growth attributed to their popular use and to propose new sources of antimicrobial agents.

Methodology. The leaves of *Sansevieria* plants, cultivated under glasshouse conditions, were sampled at M.M. Gryshko National Botanic Garden (NBG), National Academy of Science of Ukraine. Specifically, the leaves of *Sansevieria francisii* Chahin, *S. caulescens* N.E.Br., *S. suffruticosa* N.E.Br., *S. roxburghiana* Schult. & Schult.f., *S. metallica* Gérôme & Labroy, *S. gracilis* N.E.Br., *S. hyacinthoides* (L.) Druce, *S. cylindrica* Bojer ex Hook., *S. canaliculata* Carrière, *S. aethiopica* Thunb., *S. kirkii* Baker, *S. trifasciata* Prain, *S. forskaliana* (Schult. & Schult.f.) Hepper & J.R.I. Wood, *S. fischeri* (Baker) Marais, *S. dooneri* N.E.Br., *S. intermedia* N.E.Br., *S. parva* N.E.Br. were sampled for the study. Antimicrobial activity was determined using the agar disk diffusion technique.

Scientific novelty. Results proved that extracts obtained from the leaves of *S. dooneri* and *S. gracilis* were particularly active against *Acinetobacter baumannii* complex isolate (diameters of inhibition zones were 14-20.5 mm). It was followed by the activities of extracts from the *S. suffriticosa* (15.4 ± 1.11 mm), *S. fischeri* (14.7 ± 1.1 mm), *S. parva* (14.2 ± 1.1 mm), *S. canaliculate* (13.8 ± 1.18 mm), *S. trifasciata* leaves (13.7 ± 1.3 mm). Finally, the ethanolic extracts of *S. hyacinthoides* and *S. intermedia* showed fewer antimicrobial activities (diameters of inhibition zones ranged between 7.5 to 10 mm).

Conclusions. Hence, the ethanolic extracts derived from *S. dooneri* and *S. gracilis* exhibit a favorable antibacterial activity against *Acinetobacter baumannii*, indicating that these plants could be a good source of antibacterial agents to combat *A. baumannii*-mediated infections. Thus, the leaves of some plants belonging to the *Sansevieria* genus with antibacterial properties may offer alternative therapeutic agents against bacterial infections.

Keywords: *Sansevieria* genus, antibacterial activity, *Acinetobacter baumannii* complex isolate, agar diffusion susceptibility testing

АНОТАЦІЯ

Мета: У дослідженні зроблено спробу оцінити антибактеріальну активність сімнадцяти рослин роду *Sansevieria* щодо комплексного ізоляту *Acinetobacter baumannii*, стійкого до гентаміцину та ципрофлоксацину (зразок 3680, UK NEQAS). Метою дослідження була оцінка антибактеріальної активності і наукове підтвердження інгібіторної активності деяких рослин, що належать до роду *Sansevieria*, щодо росту ізоляту *Acinetobacter baumannii*.

Методологія. Зразки листя рослин сансевієрії, культивованих в тепличних умовах, відбирали в Національному ботанічному саді імені М.М. Гришка (НБС) НАН України. Зокрема, листя *Sansevieria francisii* Chahin, *S. caulescens* N.E.Br., *S. suffruticosa* N.E.Br., *S. roxburghiana* Schult. & Schult.f., *S. metallica* Gérôme & Labroy, *S. gracilis* N.E.Br., *S. hyacinthoides* (L.) Druce, *S. cylindrica* Bojer ex Hook., *S. canaliculata* Carrière, *S. aethiopica* Thunb., *S. kirkii* Baker, *S. trifasciata* Prain, *S. forskaliana* (Schult. & Schult.f.) Hepper & J.R.I. Wood, *S. fischeri* (Baker) Marais, *S. dooneri* N.E.Br., *S. intermedia* N.E.Br., *S. parva* N.E.Br. були відібрані для дослідження. Антимікробну активність визначали за допомогою дифузійного методу з використанням чашок Петрі з нанесеною культурою мікроорганізма.

Наукова новизна. Результати підтвердили, що екстракти, отримані з листя *S. dooneri* та *S. gracilis*, виявляли особливу активність щодо комплексного ізоляту *Acinetobacter baumannii* (діаметр зон інгібування був 14-20,5 мм). Нижчу активність проявили екстракти з листя *S. suffriticosa* (15,4 ± 1,11 мм), *S. fischeri* (14,7 ± 1,1 мм), *S. parva* (14,2 ± 1,1 мм), *S. canaliculate* (13,8 ± 1,18 мм), *S. trifasciata* (13,7 ± 1,3 мм). Нарешті, спиртові екстракти з листя *S. hyacinthoides* і *S. intermedia* проявили найнижчу антимікробну активність (діаметр зон інгібування коливався від 7,5 до 10 мм).

Висновки. Таким чином, спиртові екстракти, отримані з *S. dooneri* і *S. gracilis*, проявили найвищу антибактеріальну активність щодо росту *Acinetobacter baumannii*, що вказує на те, що ці рослини можуть бути адекватним джерелом антибактеріальних засобів для боротьби з інфекціями, опосередкованими *A. baumannii*. Листя деяких рослин, що належать до роду *Sansevieria* з чітко визначеними антибактерійними властивостями, можна запропонувати як альтернативні терапевтичні засоби проти бактеріальних інфекцій.

Ключові слова: рід *Sansevieria*, антибактеріальна активність, *Acinetobacter baumannii*, диско-дифузійний метод Кірбі-Бауера

Introduction

Genus *Sansevieria*, belonging to *Asparagaceae* family, comprises ca. 70 species worldwide, distributed mainly in dry or arid areas of the Old World tropics and subtropics [8; 30], with a distribution range from Africa to southeast Asia and the islands of the Indian Ocean [4; 26]. Representatives of this genus are usually xerophytic perennial rhizomatous plants that occur in dry tropical and subtropical parts of the world [8; 30]. Africa is the center of diversity for *Sansevieria* [12]. Some *Sansevieria* species occur in clumps at the bases of trees [8; 30].

Sansevieria is a source of white strong elastic fiber commonly used in the manufacture of rope, fishing lines, cordage, fine matting, bowstring, and clothing [31]. It is well known that some *Sansevieria* species have horticultural value [17; 30]. For example, a number of species such as *S. cylindrical*, *S. trifasciata*, *S. roxburghiana*, *S. zeylanica* are grown as ornamental plants. Moreover, *S. trifasciata* is believed to have air-purifying properties, removing indoor toxins like formaldehyde, nitrogen and sulfur oxides [14]. It should be noted that some *Sansevieria* species have become widely naturalized in parts of the world. Escaped to the south and central Florida, *S. hyacinthoides* is listed as a Category II invasive plant by the Florida Exotic Pest Plant.

Comprehensive information concerning ethnobotanical uses of various *Sansevieria* species in Kenya was presented and critically evaluated by Takawira-Nyenya and coauthors (2014) [32]. For example, Bally (1937) reported that *Sansevieria kirkii* Baker roots are used for the treatment of foot sores (cited by [32]). In studies carried out in Nakuru and Maragua districts of Kenya by Khalumba and co-workers (2005), they identified five use categories of *Sansevieria* plants, namely medicine (33 % of the reports), fibers (24 %), soil conservation (22 %), fodder (18 %), and other uses (14 %) for four species, *Sansevieria ehrenbergii* Schweinf. ex Baker, S. *parva*, *S. raffillii* N.E. Br., and *S. suffruticosa* N.E. Br. [17]. Chhabra and colleagues (1987) mentioned the use of *Sansevieria bagamoyensis* N.E.Br. for the treatment of convulsive fever in Tanzania [13]. Watt and Breyer-Brandwijk (1962) listed the use of *Sansevieria hyacinthoides* (L.) Druce in the treatment of toothache and earache and the use of the rhizome decoction of *S. kirkii* as a purgative both reported from East Africa [34]. Yet, Kiringe (2006) reported on the use of *Sansevieria volkensii* Gürke for the treatment of sexually transmitted diseases such as gonorrhea [18]. In Kenya, Owuor and Kisangau (2006) included the use of *Sansevieria parva* N.E.Br. leaf sap for treatment of snakebite wounds and *S. kirkii* extracts for treatment of snakebite wounds [23]. Nevertheless, in spite of these data, Takawira-Nyenya with coauthors (2014) reported that the documentation of ethnobotanical uses of genus *Sansevieria* is incomplete [32].

Leaf and root preparations of the *S. liberica* Gérôme & Labroy are used in the treatment of hemorrhoids, pain, smallpox, chicken-pox, and measles, venereal diseases, malnutrition, paralysis, epilepsy, convulsions, and spasm, pulmonary troubles, and as vermifuge [9], as well as remedy for parasitic infections [7]. Preparations of the *S. liberica* are used in the treatment of ear and eye infections, inflammation (leaf juice), toothache (fruit juice together with fluid from snails), fever, headache, and cold (fume from burning leaves inhaled), cough, pain, inflammation, infections, convulsion, diarrhea, and as stimulating tonic (root decoction) [3]. Adeyemi and co-workers (2009) have evaluated the antidiarrhoeal activity of aqueous root extract of *S. liberica* using various pharmacological models (the intestinal transit, castor oil-induced diarrhea, enter polling, and gastric emptying). The aqueous root extract of *S. liberica* possesses antidiarrhoeal property due to inhibition of gastrointestinal propulsion and fluid secretion, possibly mediated through inhibition of the nitric oxide pathway. This justifies the use of the plant extract in traditional African medicine for the treatment of diarrhea [1]. The central nervous system depressant and anticonvulsant activities of the aqueous root extract of *S. liberica* on various animal models including pentobarbitone sleeping time and hole-board exploratory behavior for sedation tests, and strychnine, picrotoxin, bicuculline and pentylenetetrazole-induced convulsions in mice were investigated by Adeyemi and co-workers (2007). Their results indicated that the aqueous root extract of *S. liberica* has sedative and anticonvulsant activities, therefore, justifying its use in traditional African medicine [2].

S. roxburghiana Schult. & Schult.f. is used for coughs, rheumatism; as an expectorant, febrifuge, purgative, and tonic [16]. The study of Haldar and co-workers (2010) has demonstrated that the hydroalcoholic extract of *S. roxburghiana* rhizome exhibited remarkable antitumor activity against Ehrlich ascites carcinoma in Swiss mice that is plausibly attributable to its augmenting endogenous antioxidant mechanisms [16]. In addition, diethyl ether, alcohol, and acetone extracts of *S. roxburghiana* rhizome showed antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Staphylococcus aureus* [29].

In our study, an attempt has been made to evaluate the antibacterial activity of seventeen plants belonging to the *Sansevieria* genus against *Acinetobacter baumannii* complex isolate, resistant to gentamicin and ciprofloxacin (specimen 3680, UK NEQAS). The aim of the present study was to evaluate the antibacterial capacity and to validate scientifically the inhibitory activity of some plants belonging to the *Sansevieria* genus for microbial growth attributed to their popular use and to propose new sources of antimicrobial agents. The selected bacterial strain *A. baumannii* is an opportunistic pathogen and one of the six most important multidrug-resistant microorganisms in hospitals worldwide responsible for hospital-acquired nosocomial infections [5; 20]. This human pathogen is responsible for a vast array of infections, i.e. ventilator-associated and bloodstream infections in critically ill patients, and mortality rates can reach 35 % [5]. Due to the prevalence of infections and outbreaks caused by multi-drug resistant *A. baumannii*, few antibiotics are effective for treating infections caused by this pathogen [20].

Materials and methods

Collection of Plant Materials. The leaves of *Sansevieria* plants, cultivated under glasshouse conditions, were sampled at M.M. Gryshko National Botanic Garden (NBG), National Academy of Science of Ukraine. Specifically, the leaves of *Sansevieria francisii* Chahin, *S. caulescens* N.E.Br., *S. suffruticosa* N.E.Br., *S. roxburghiana* Schult. & Schult.f., *S. metallica* Gérôme & Labroy, *S. gracilis* N.E.Br., *S. hyacinthoides* (L.) Druce, *S. cylindrica* Bojer ex Hook., *S. canaliculata* Carrière, *S. aethiopica* Thunb., *S. kirkii* Baker, *S. trifasciata* Prain, *S. forskaliana* (Schult. & Schult.f.) Hepper & J.R.I. Wood, *S. fischeri* (Baker) Marais, *S. dooneri* N.E.Br., *S. intermedia* N.E.Br., *S. parva* N.E.Br. were sampled for the study. Various databases available for searching collections of living plants, e.g. World Checklist of Selected Plant Families (WCSP, 2018), International Plant Names Index, The Plant List, have been used for the taxonomic identity of plants screened (Fig. 1).

Preparation of Plant Extracts. Freshly leaves were washed, weighed, crushed, and homogenized in 96 % ethanol (in the proportion of 1:19, w/w) at room temperature. The extracts were then filtered and investigated for their antimicrobial activity. All extracts were stored at 4°C until use.

Bacterial strain. For the study, *Acinetobacter baumannii* complex isolate 3680 (UK NEQAS, The United Kingdom National External Quality Assessment Service) was used. It contained an *A. baumannii* complex isolate, resistant to gentamicin and ciprofloxacin. The organism was borderline susceptible to imipenem and meropenem and only 14.3 % of participants reported intermediate or resistant [28].

Agar diffusion susceptibility testing. Antimicrobial activity was determined using the agar disk diffusion technique [6]. The *A. baumannii* strain was obtained from the Department of Bacteriology, Regional Hospital in Koszalin (West-Pomeranian Voivodeship, Poland). The strain was grown in a test tube containing 45 mL of sterile nutrient broth (Oxoid™ Ltd.) at 37 °C for 24 hours. The purity of the inoculum was confirmed by plating on appropriate selective media and microscopic examination of the Gram-stained smear. The culture was inoculated onto Mueller-Hinton (MH) agar plates. Sterile filter paper discs impregnated with extracts were applied over each of the culture plates. Isolates of bacteria were then incubated at 37 °C for 24 h. The plates were then observed for the zone of inhibition produced by the antibacterial activity of various ethanolic extracts obtained from the leaves of plants. The presence of inhibition zones around each of the paper discs after the period of incubation was regarded as the presence of antimicrobial action while the absence of any measurable zone of inhibition was interpreted as the absence of antimicrobial action. Negative control discs impregnated with sterile ethanol were used in each experiment. The plates were observed and photographs were taken. For each extract, eight replicate trials were conducted. Zone diameters were determined and averaged.

S. aethiopica Thunb.

S. cylindrica Bojer ex Hook.

S. metallica Gérôme & Labroy

S. caulescens N.E.Br.

S. fisheri (Baker) Marais

S. canaliculata Carrière

S. francisii Chahin.

S. parva N.E. Br.

S. trifasciata Prain

S. kirkii Baker

Fig. 1. Specimens of *Sansevieria* plants cultivated at M.M. Gryshko National Botanic Garden (Kyiv, Ukraine). Photo: Myroslava Maryniuk, Lyudmyla Buyun.

Statistical analysis. Statistical analysis of the data obtained was performed by employing the mean ± standard error of the mean (S.E.M.). All variables were tested for normal distribution using the Kolmogorov-Smirnov test ($p > 0.05$). In order to find significant differences (significance level, $p<0.05$) between groups, the Kruskal-Wallis test by ranks was applied to the data [35]. All statistical analyses were performed using STATISTICA 13.3 software (TIBCO Software Inc., Krakow, Poland). The following zone diameter criteria were used to assign susceptibility or resistance of bacteria to the phytochemicals tested: Susceptible (S) ≥ 15 mm, Intermediate (I) = 11-14 mm, and Resistant (R) ≤ 10 mm [22].

Results and discussion

Antimicrobial activity of various ethanolic extracts obtained from leaves of some plants belonging to the *Sansevieria* genus against *A. baumannii* measured as inhibition zone diameter is shown in Fig. 1 and 2. The present study has shown that ethanolic extracts obtained from leaves of these species exhibited intermediated activity against *A. baumannii*.

The diameters of inhibition zones ranged between 8 to 18.5 mm, which are also shown in Fig. 1. Extracts from the leaves of *S. dooneri* and *S. gracilis* were particularly active against strain tested (diameters of inhibition zones were 17.1 ± 1.3 mm and 15.5 ± 0.9 mm, respectively). It was followed by the activities of extracts from the *S. suffriticosa* (15.4 ± ± 1.11 mm), *S. fischeri* (14.7 ± 1.1 mm), *S. parva* (14.2 ± ± 1.1 mm), *S. canaliculate* (13.8 ± 1.18 mm), *S. trifasciata* leaves (13.7 ± 1.3 mm). Finally, the ethanolic extracts of *S. hyacinthoides* and *S. intermedia* showed less antimicrobial activities (diameters of inhibition zones were ranged between 7.5 to 10 mm) (Fig. 1 and 2).

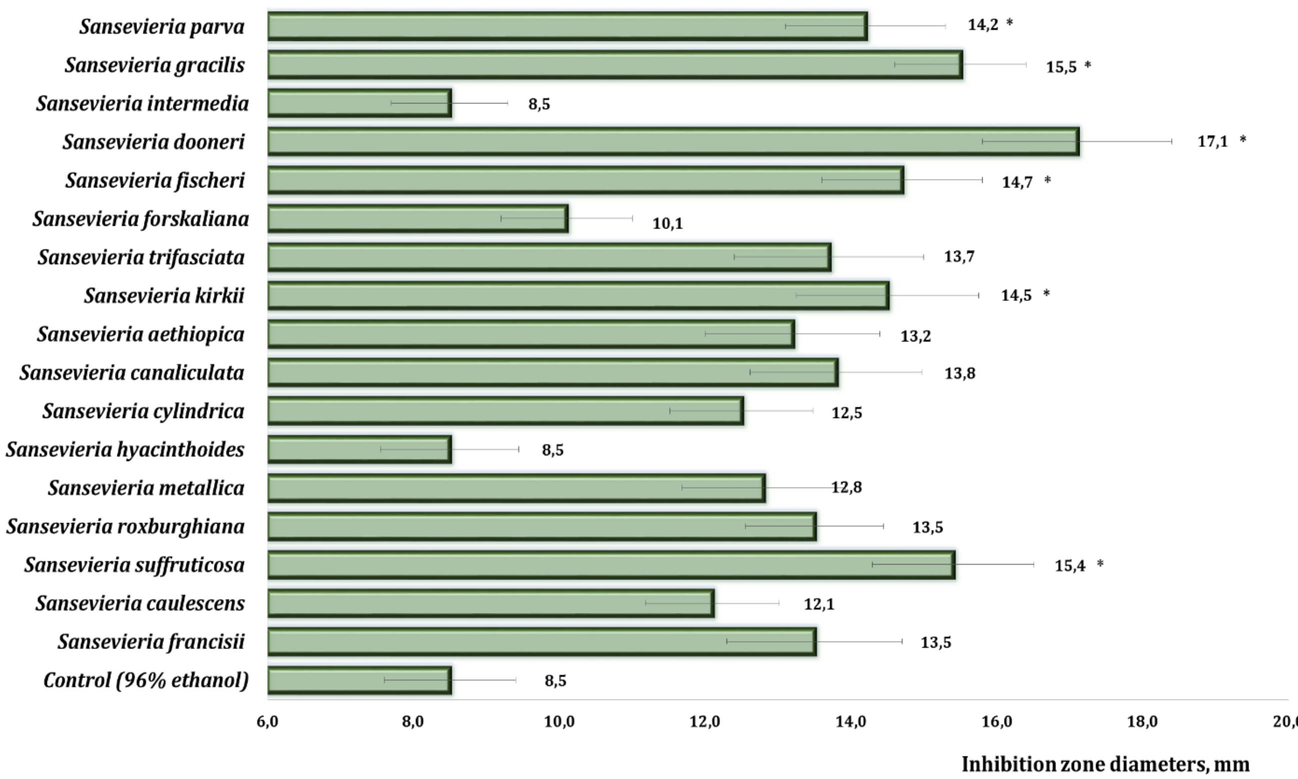

Fig. 1. The mean values of diameters of inhibition zones obtained by the impact of various ethanolic extracts derived from leaves of *Sansevieria* plants against *A. baumannii* (M ± m, n = 8).
*** denote significant differences between the control (96% ethanol) and *Sansevieria* extracts ($p < 0.05$).**

The mean of diameters of inhibition zones of various ethanolic extracts obtained from leaves of *Sansevieria* plants against *A. baumannii* was increased by 58.8 %, p > 0.05 (for *S. francisii*), 42.4 %, p > 0.05 (for *S. caulescens*), 81.2 %, p < 0.05 (for *S. suffruticosa*), 58.8 %, p > 0.05 (for *S. roxburghiana*), 50.6 %, p > 0.05 (for *S. metallica*), 82.4 %, p < 0.05 (for *S. gracilis*), 47.1 %, p > 0.05 (*S. cylindrica*), 62.4 %, p>0.05 (*S. canaliculata*), 55.3 %, p > 0.05 (*S. aethiopica*), 70.6 %, p < 0.05 (*S. kirkii*), 61.2 %, p > 0.05 (*S. trifasciata*), 18.8 %, p > 0.05 (*S. forskaliana*), 72.9 %, p < 0.05 (for *S. fischeri*), 101.2 %, p < 0.05 (*S. dooneri*), 67.1 %, p < 0.05 (*S. parva*) compared to the negative control (96 % ethanol) (Fig. 1).

Detailed data regarding the diameters of inhibition zones of strain tested by the various plant extracts were recorded and presented in Fig. 2.

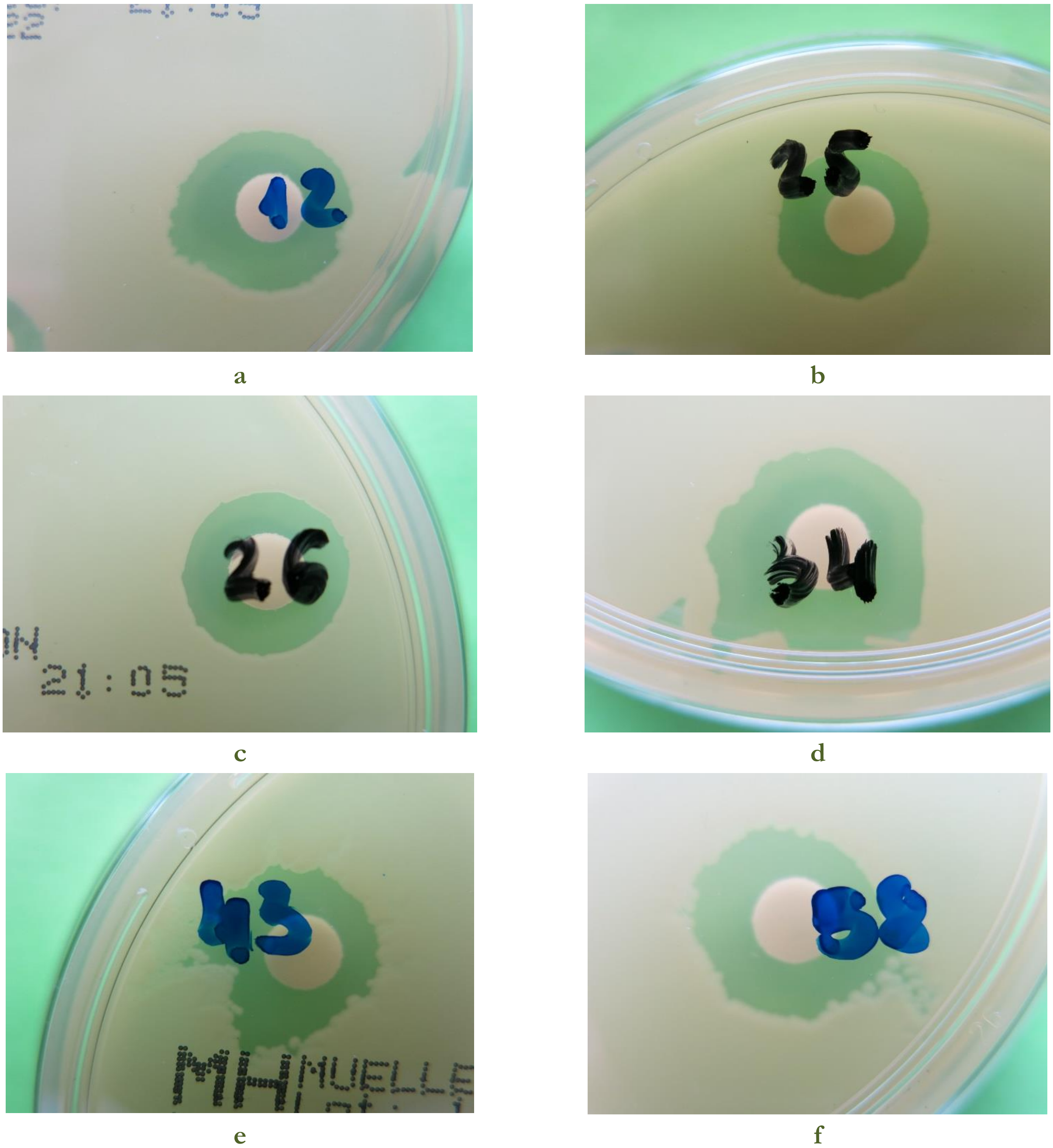

Fig. 2. Antimicrobial activity of various ethanolic extracts derived from leaves of *S. dooneri* (a), *S. fischeri* (b), *S. parva* (c), *S. gracilis* (d), *S. kirkii* (e), *S. suffriticosa* (f) against *A. baumannii* measured as inhibition zone diameter.

After the emergence of multi-drug resistant pathogens, the research for new remedy alternatives has led to the recognition of the potential of medicinal plant extracts for treating the infections associated with these species of microorganisms [27]. Therefore, this study aimed to determinate the antimicrobial activity of ten plants from the *Sansevieria* genus commonly used in traditional medicine in order to validate scientifically their therapeutic properties. The use of these plants in folk medicinal remedies for treating various health problems has already been reported, and the plants have been tested in the treatment of hemorrhoids, pain, smallpox, chicken-pox, and measles, venereal diseases, malnutrition, paralysis, epilepsy, convulsions, and spasm, pulmonary troubles, and as vermifuge [9], as well as remedy for parasitic infections [7].

By the agar diffusion method, the ethanolic extracts from *S. dooneri* and *S. gracilis* showed the highest anti-*A. baumannii* activity, evidencing that ethanol is an efficient organic solvent to be used for the extraction of bioactive plant materials. In our previous study [11], we have evaluated the antibacterial capacity of ten species of *Sansevieria* genus against *Staphylococcus aureus* in order to validate scientifically the inhibitory activity for microbial growth attributed by their popular use and to propose new sources of antimicrobial agents. Our results proved that the zones of inhibition ranged between 16 to 34 mm. Extracts from the leaves of *S. fischeri* and *S. francisii* were particularly active against tested organisms (diameters of inhibition zones comprise up to 34 mm). This was followed by the activities of extracts from the *S. parva, S. kirkii, S. aethiopica, S. caulescens, S. metallica* leaves (diameters of inhibition zones were ranged between 25 to 31 mm). The ethanolic extracts of *S. canaliculata* and *S. trifasciata* showed fewer antimicrobial activities (diameters of inhibition zones ranged between 16 to 16.5 mm). The results proved that the ethanolic extracts from *S. fischeri, S. francisii, S. parva, S. kirkii, S. aethiopica, S. caulescens, S. metallica* exhibit a favorable antibacterial activity against *S. aureus* [11].

Our previous results also revealed the antimicrobial potential of these extracts against *Escherichia coli* strain [33]. The test organism was susceptible to extracts obtained from the leaves of *S. kirkii*, *S. arborescens*, *S. roxburghiana*, *S. francisii*, *S. forskaliana*, *S. cylindrica*, *S. trifasciata*, *S. canaliculata*, *S. caulescens*, *S. metallica*, *S. aethiopica* with diameters of inhibition zone from 12 to 24 mm. *Escherichia coli* isolate was resistant only to *S. hyacinthoides* extract and the diameter of zone inhibition around the rest ranged from 8 to 10 mm [33].

The antibacterial properties of ethanolic extract prepared from *Sansevieria aethiopica* against *E. coli, S. aureus,* and *P. aeruginosa* strains, were assessed [21]. For our previous study, a panel of organisms including *S. aureus* subsp. *aureus* Rosenbach ATCC®25923™ (mecA negative), *S. aureus* subsp. *aureus* Rosenbach ATCC®29213™ (mecA negative, Oxacillin sensitive, weak β-lactamase-producing strain), *S. aureus* NCTC®12493™ (mecA positive, Methicillin-resistant, EUCAST QC strain for cefoxitin), *E. coli* (Migula) Castellani and Chalmers ATCC®25922™, *E. coli* (Migula) Castellani and Chalmers ATCC®35218™, *P. aeruginosa* (Schroeter) Migula ATCC®27583™ were used. The results of antibacterial assays revealed that plant extract has exhibited the highest antibacterial activity against *S. aureus* as compared to the *E. coli* and *P. aeruginosa* strains. The diameters of inhibition zones were (26.35 ± 1.26) mm, (16.15 ± 1.47) mm, and (21.6 ± 1.23) mm for *S. aureus* subsp. *aureus* Rosenbach ATCC®25923™, *S. aureus* subsp. *aureus* Rosenbach ATCC®29213™, and *S. aureus* NCTC®12493™, respectively. Conversely, the extract has shown less antimicrobial activities against *P. aeruginosa*. The mean of the inhibition zone was (12.49 ± 1.09) mm. Finally, the ethanolic extract of *S. aethiopica* leaves exhibited mild antibacterial activity against *E. coli* [mean of inhibition zone ranged (18.62 ± ± 1.32 mm) for *E. coli* (Migula) Castellani and Chalmers ATCC®25922™ and (16.38 ± 1.02) mm for *E. coli* (Migula) Castellani and Chalmers ATCC®35218™] [21]. The extract of *S. cylindrica* has shown better activity against *S. aureus* and *P. aeruginosa* strains compared to the *E. coli* strains. The diameters of inhibition zones were (22.5 ± 1.24) mm, (20.5 ± 1.3) mm, and (16.4 ± 0.95) mm for *S. aureus* subsp. *aureus* Rosenbach ATCC®25923™, *S. aureus* subsp. *aureus* Rosenbach ATCC®29213™, and *S. aureus* NCTC®12493™, respectively. The extract of *S. cylindrica* has shown less antimicrobial activities against *P. aeruginosa* (Schroeter) Migula ATCC®27583™. Finally, the ethanolic extract exhibited mild antibacterial activity against *E. coli* strains [10].

Many *Sansevieria* species possess antibacterial activity against bacterial strains, as reported in many studies. For example, Febriani and co-workers (2019) found the profile of chemical compounds by thin layer chromatography method and determine the antibacterial activity of Lidah Mertua (*Sansevieria trifasciata* Prain.) leaves *in vitro* [15]. The result of the research on thin-layer chromatography showed that the compounds contained in the *S. trifasciata* leaves were polyphenols, steroids, and alkaloids. The antibacterial activity showed that n-hexane extract does not provide inhibitory activity. Minimum inhibitory concentration (MIC) values showed that ethyl acetate extract of *S. trifasciata* leaves inhibited the growth of *E. coli* and *S. aureus* at concentrations 50 mg/mL and 25 mg/mL with diameters of inhibition zone was 8.50 mm and 8.20 mm and methanol extract of *S. trifasciata* leaves inhibited the growth of *E. coli* and *S. aureus* at concentration 12.5 mg/mL and 25 mg/mL with diameters of inhibition zone is 8.46 mm and 8.32 mm. The antibacterial activity revealed that n-hexane extract did not provide inhibitory activity, but ethyl acetate extract of *S. trifasciata* leaves inhibited the growth of *E. coli* and *S. aureus* [15].

By the agar diffusion method, the ethanolic extracts derived from *S. fischeri*, *S. francisii*, *S. parva*, *S. kirkii*, *S. aethiopica*, *S. caulescens*, and *S. metallica* showed anti-*S. aureus* activity, evidencing that ethanol is an efficient organic solvent to be used for the extraction of bioactive plant materials. The microbial growth inhibition capacity relies on the rich variety of phytochemicals including carbohydrates, saponins, flavonoids, phenols, alkaloids, anthocyanin and cyanine, glycosides, proteins, and phytosterols [24, 25]. The phytochemical screening revealed the high presence of alkaloids in the methanolic extract of *S. roxburghiana* compared to acetone, chloroform, and ether. Flavonoids were present in ethanolic and ether extracts in moderate proportions; saponins were present in ethanolic and methanolic extracts in moderate proportions. Steroids were shown in higher proportions in methanol, chloroform, and ether and moderate in acetone; terpenoid's presence was shown in chloroform and absent in all rest of the extracts. Tannins were high in acetone and methanol and moderate in ethanol and chloroform. Phenols were only in methanol fractions, while quinones were presented in methanol, chloroform, and ether at moderate levels [19].

Considering the medicinal importance of the tested microorganism, the findings of this study are considered to be very promising from the perspective of new drug discovery from plant sources. Further chemical analysis of the aforementioned plant extracts should be performed to determinate their chemical composition and identify precisely the exact phytocompounds responsible for antimicrobial activity as well as to assess their *in vivo* efficacy, toxicity, potential adverse effects, interactions, and contraindications.

Conclusions

Our results proved that extracts obtained from the leaves of *S. dooneri* and *S. gracilis* were particularly active against *Acinetobacter baumannii* complex isolate (diameters of inhibition zones were 14-20.5 mm). It was followed by the activities of extracts from the *S. suffriticosa* (15.4 ± 1.11 mm), *S. fischeri* (14.7 ± 1.1 mm), *S. parva* (14.2 ± 1.1 mm), *S. canaliculate* (13.8 ± 1.18 mm), *S. trifasciata* leaves (13.7 ± 1.3 mm). Finally, the ethanolic extracts of *S. hyacinthoides* and *S. intermedia* showed less antimicrobial activities (diameters of inhibition zones were ranged between 7.5 to 10 mm). Hence, the ethanolic extracts derived from *S. dooneri* and *S. gracilis* exhibit a favorable antibacterial activity against *Acinetobacter baumannii*, indicating that these plants could be a good source for the antibacterial agents to combat *A. baumannii*-mediated infections. Thus, the preliminary screening assay indicated that the leaves of *S. cylindrica* with antibacterial properties may offer alternative therapeutic agents against bacterial infections. Thus, the leaves of some plants belonging to the *Sansevieria* genus with antibacterial properties may offer alternative therapeutic agents against bacterial infections. On the basis of the results obtained, we conclude that the crude extracts of some *Sansevieria* species exhibited significant antimicrobial activity and properties that support folkloric use in the treatment of some diseases as broad-spectrum antimicrobial agents.

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Received: 25.10.2022. **Accepted**: 08.12.2022. **Published**: 29.12.2022.

Cite this article in APA Style as:

Tkachenko, H., Buyun, L., Kurhaluk, N., and Maryniuk, M., (2022). The antibacterial properties of ethanolic extracts obtained from leaves of some plants belonging to the *Sansevieria* Thunb. genus against *Acinetobacter baumannii* strain. *BHT: Biota. Human. Technology*, 2, 30-43. (in English)

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